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# UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new non-provisional applications under 37CFR§1.53(b))

Attorney Docket No.	7146.055
First Inventor or Application Identifier	Bryan S. Hallberg
Title	METHOD AND APPARATUS FOR STORING MPEG-2 TRANSPORT STREAMS USING A CONVENTIONAL DIGITAL VIDEO RECORDER
Express Mail Label No.	EL399605856US

**APPLICATION ELEMENTS**

See MPEP chapter 600 concerning utility patent application contents.

Assistant Commissioner for Patents

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1. <input checked="" type="checkbox"/> *Fee Transmittal Form (e.g. PTO/SB/17) <i>(Submit an original and a duplicate for fee processing)</i>	5. <input type="checkbox"/> Microfiche Computer Program (Appendix)			
2. <input checked="" type="checkbox"/> Specification	Total pages			
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a. <input checked="" type="checkbox"/> Newly executed (original or copy)  b. <input type="checkbox"/> Copy from a prior application (37 CFR §1.63(d)) <i>(for continuation/divisional with Box 16 completed)</i>  i. <input type="checkbox"/> <u>Deletion of Inventor(s)</u> Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR §§1.53(d)(2) and 1.33(b)				
<b>Note for Items 1 &amp; 13:</b> In order to be entitled to pay small entity fees, a small entity statement is required (37 CFR §1.27), except if one filed in a prior application is relied upon (37 CFR §1.28).				
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Name	Chernoff, Vilhauer, McClung & Stenzel L.L.P.			
Address	1600 ODS Tower 601 S W. Second Avenue			
City	Portland	State	Oregon	
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Name (print type)	Timothy A. Long		Registration No. (Attorney/Agent)	28,876
Signature	<i>Timothy A. Long</i>		Date	December 16, 1999

- 7.  Assignment Papers (cover sheet & document(s))
- 8.  37 CFR §3.73(b) Statement  Power of Attorney  
*when there is an assignee*
- 9.  English translation document (*if applicable*)
- 10.  Information Disclosure Statement (IDS) /PTO  
1449       Copies of IDS Citations
- 11.  Preliminary Amendment
- 12.  Return Receipt Postcard (MPEP 503)  
*(should be specifically itemized)*
- 13.  \*Small Entity Statements (PTO/sb/09-12)       Statement filed in prior application.  
Status still proper and desired.
- 14.  Certified Copy of Priority Document(s)  
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 Continuation     Divisional     Continuation-in-part (CIP)    of prior application No.: \_\_\_\_\_

Prior application information: Examiner \_\_\_\_\_ Group No./Art Unit \_\_\_\_\_

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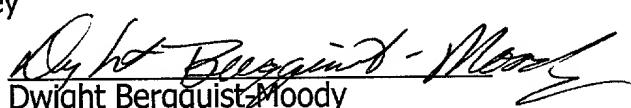
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Date of Deposit: December 16, 1999

I hereby certify that the documents listed below and attached hereto, submitted by Bryan S. Hallberg and Jeffrey B. Sampsell, for a new U.S. Patent application filed concurrently herewith entitled METHOD AND APPARATUS FOR STORING MPEG-2 TRANSPORT STREAMS USING A CONVENTIONAL DIGITAL VIDEO RECORDER, including the required fees, are being deposited with the United States Postal Service as express mail in an envelope addressed to: Assistant Commissioner for Patents, Box Patent Application, Washington, D.C. 20231 on December 16, 1999.

The specific documents served herewith are:

- |                                                                             |                         |
|-----------------------------------------------------------------------------|-------------------------|
| 1. Utility Patent Application Transmittal                                   | 10. Power of Attorney   |
| 2. Fee Transmittal (in duplicate)                                           | 11. Check #51866 in the |
| 3. Specification (17 pages)                                                 | amount of \$1,244.00    |
| 4. Drawings (6 pages)                                                       | 12. Confirmation Card   |
| 5. Declaration (3 pages)                                                    |                         |
| 6. Assignment                                                               |                         |
| 7. Recordation Form Cover Sheet                                             |                         |
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Dwight Bergquist-Moody

METHOD AND APPARATUS FOR STORING MPEG-2 TRANSPORT STREAMS  
5                   USING A CONVENTIONAL DIGITAL VIDEO RECORDER

BACKGROUND OF THE INVENTION

The present invention relates to a digital video recorder and, more particularly, to a method and apparatus for storing a compressed MPEG-2  
10 transport data stream with a conventional digital video recorder.

A conventional digital video (DV) recorder records a digitized version of an analog television signal. The analog signal may be the signal of the NTSC (National Television Systems Committee) color television system of the United States and Japan, the PAL (Phase Alteration Line Rate) television system of parts  
15 of Europe, or the SECAM (Se'quentiel Couleur 'a Memoire) television system of France, Russia and eastern Europe. For example, to digitally record the analog television signal of the NTSC system, the separate luminance and chrominance signals of the video signal are first sampled and quantized. Intraframe compression is applied to the digital data representing the video signal using  
20 techniques such as adaptive quantization (AQ), discrete cosine transformation (DCT), and variable length coding (VLC). Following compression, error correction is added to the data. The audio portion of the signal is processed in a similar manner. The digital audio and video data are copied to data elements of a digital video (DV) frame data structure and the audio and video data elements of the DV  
25 frame structure are stored as separate segments of recording tracks on a magnetic tape.

The input and output of most DV recorders are by means of isochronous data transport as defined by the IEEE 1394-1995, STANDARD FOR A HIGH PERFORMANCE SERIAL BUS, incorporated herein by reference. The  
30 IEEE 1394 standard defines a basic mechanism for real time data transport

including an isochronous data packet 10, as illustrated in FIG. 1. However, the IEEE 1394 standard does not establish the protocols needed for specific application requirements such as sending DV data over the bus. The format of the data structure for isochronous transmission of DV data across the IEEE 1394 serial bus is described in the International Standards Organization (ISO)/International Electrotechnical Commission (IEC) standards for DIGITAL INTERFACE FOR CONSUMER ELECTRONIC AUDIO/VIDEO EQUIPMENT, ISO/IEC 61883-1 and 61883-2, incorporated herein by reference. ISO/IEC 61883 defines the Common Isochronous Packet (CIP) format that is the basis of the 1394 DV data packet 30, illustrated in FIG. 2. The DV packet 30 comprises a CIP header 32 and a data field 34 of 480 bytes. For isochronous transmission on the IEEE 1394 bus, the DV data packet 30 is inserted into the data block of the IEEE 1394 isochronous data packet 10.

The IEEE 1394 bus sequences through three general phases: a cycle initiation phase, an isochronous phase, and an asynchronous phase. At the completion of the cycle initiation phase, transfer of isochronous data packets 10 is enabled. Devices connected to the bus having an allocated isochronous channel arbitrate for the bus. When a device gains access to the bus, it locates the start of the DV video frame and buffers the next 250 valid data packets to collect a complete DV frame. The CIP headers are discarded and the remaining 120,000 bytes defines an NTSC DV frame.

A 525 lines, NTSC DV video frame 50 comprises odd and even video fields and is encoded into ten digital interface format (DIF) sequences 52, as illustrated in FIG. 3. Each DIF sequence 54 comprises 150 DIF blocks 54 as illustrated in FIGS. 3 and 4. The 150 DIF blocks comprise a header (H) section 70, a subcode (SC) section 72, a video auxiliary (VAUX) section 74, and an audio and video data section 75. The audio data section 76 (indicated by a bracket in FIG. 4) comprises nine ( $A_0$ - $A_8$ ) audio DIF blocks. The video portion of the audio-video section 75 comprises 135 ( $V_0$ - $V_{134}$ ) video DIF blocks 78 (indicated by a bracket in FIG. 4). Referring to FIG. 3 each DIF block 54 includes an ID

section 56 and a data section 58.

Digital recording of analog television signals provides a number of advantages over analog recording of those signals. However, television is in transition from an analog system to a digital system based on the MPEG-2 video compression standard. In the digital television (DTV) system, signals for each of the elements of a television program are digitized. The digital elementary data streams are compressed and then multiplexed into a single MPEG-2 transport data stream for transmission to a receiver. At the receiver, the transport stream is separated into the constituent elementary data streams which are decompressed and presented to the viewer. MPEG-2 transport data streams can be recorded with a dedicated MPEG video recorder. However, purchasing a dedicated video recorder to record MPEG video, particularly during the transition to DTV, is an undesirable additional expense.

What is desired, therefore, is a method of storing an MPEG transport data stream on a conventional DV format video recorder for playback on a DTV receiver.

## SUMMARY OF THE INVENTION

The present invention overcomes the aforementioned drawbacks of the prior art by providing a method of processing data comprising the steps of copying the data to a data block formatted for digital video, and storing the data block on a storage medium in a digital video storage format. For example, packetized MPEG-2 transport stream data can be stored on a conventional digital video (DV) recorder by copying the transport stream data to one or more digital interface format (DIF) data blocks that are part of a digital video (DV) frame data structure. The DV frames containing the transport stream data are then recorded on video tape. The DV frames can be input to the video recorder by insertion into isochronous data transfer packets for transfer over an IEEE 1394 bus. On the other hand, if the data is formatted according to MPEG or another data formatting standard supported by IEEE 1394, the data may be transferred to the recorder

before being inserted into a DV frame for storage. To present the stored data, the data is extracted from the DV frames and then decoded and presented using the customary applicable methods.

An apparatus for storing data with a digital video recorder is also disclosed  
5 comprising an accumulation buffer to accumulate a predetermined quantity of the  
data and a frame packetizer to copy the data to a data block of a digital video  
frame.

The foregoing and other objectives, features and advantages of the  
invention will be more readily understood upon consideration of the following  
10 detailed description of the invention, taken in conjunction with the accompanying  
drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an illustration of the data structure of an IEEE 1394 isochronous  
15 data packet.

FIG. 2 is an illustration of the data structure of a digital video data packet to  
be inserted into the data block of the IEEE 1394 isochronous data  
packet of FIG. 1.

FIG. 3 is an illustration of the data structure of a digital video frame.

20 FIG. 4 is an illustration of the data structure of a digital interface format  
(DIF) sequence of the digital video frame of FIG. 3.

FIG. 5 is a block diagram of a digital television (DTV) system, including a  
digital video recorder.

25 FIG. 6 is an illustration of the structure of a digital interface format (DIF)  
block of a DV frame in which MPEG transport stream data is stored.

FIG. 7 is an illustration of an embodiment of a header for the MPEG  
transport stream data stored in a digital interface format (DIF) block  
of a DV frame as illustrated in FIG. 6.

#### 30 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 5, a digital television system comprises, generally, a transmitter or emission station 100 (indicated by a bracket), a transmission channel 102 (indicated by a bracket), a receiver 104 (indicated by a bracket), and a monitor 106. In the emission station 100, separate video 108, audio 110, and data 112 elementary data streams are appropriately encoded and compressed in video 114, audio 116, and data 118 encoders. The compressed elementary data streams are input to a program multiplexer 120 that combines the separate elementary data streams into a single transport data stream 122. The transport data stream 122 is transmitted to a receiver 104 over a transmission channel 102 such as a terrestrial or satellite broadcast system or a cable. At the receiver 104 which may be a set-top-box, the MPEG-2 transport data stream is separated into its constituent compressed video 124, audio 126, and data 128 elementary streams by a demultiplexer 130. The individual elementary data streams are decompressed and decoded in video 132, audio 134, and data 136 application decoders. The decompressed and decoded video 138, audio 140, and data 142 elementary streams are input to a presentation system 144 for presentation to the viewer, usually by display on the monitor 106.

The receiver 104 may be connected to a digital video (DV) format video recorder or camcorder 146 by a bus 148 conforming to the IEEE 1394-1995,

STANDARD FOR A HIGH PERFORMANCE SERIAL BUS. In the present invention, the packetized MPEG-2 transport stream data 122 is inserted into a DV data packet by a frame packetizer 150. The DV frame is, in turn, inserted into an IEEE 1394 isochronous transfer data packet by an IEEE 1394 isochronous data encoder 152 for transmission over the IEEE 1394 bus 148 to the video recorder 146. In the video recorder 146, the DV data packets are recovered from the transfer data packets by a depacketizer 153 and the DV formatted frames are stored on a storage medium 154, usually a DV formatted magnetic videotape. At play time, the DV formatted data are inserted into an IEEE 1394 isochronous packet by an encoder 155 and transmitted over the bus 148 to the transmission channel 102 and to the receiver 104 where the MPEG data is extracted. The

MPEG transport stream data are decoded by the application decoders 132, 134, and 136 for display by the presentation system 144.

The IEEE 1394 standard also provides a mechanism for transferring data in  
5 an MPEG format over the serial bus 148. As an alternative embodiment, the  
transport stream data 122 could be encoded in the IEEE 1394 encoder as MPEG  
formatted data encapsulated in an IEEE 1394 packet. At the recorder 146, the  
MPEG data would be extracted from the IEEE 1394 data packet in the  
depacketizer 153. In this embodiment, the MPEG data would be inserted into the  
10 DV data format by a DV frame packetizer 157 in the recorder 146. The DV  
formatted data would then be stored on the storage medium 154. At play time,  
the DV formatted data would be copied from the storage medium 154 by the  
encoder 155. In the encoder 155, the MPEG data is extracted from the DV  
formatted data packets and then the MPEG data is inserted into an IEEE 1394  
15 data packet for transmission over the serial bus 148. In this alternative  
embodiment, the MPEG data would be recovered from the IEEE 1394 packet in  
the reconstruction depacketizer 159.

The IEEE 1394 high speed serial bus 148 provides for both asynchronous  
and isochronous data transfer. Isochronous operation guarantees a bandwidth for  
20 devices, such as audio/video devices, that require constant data transfer rates.  
Isochronous transactions use a single isochronous data packet format to perform  
multicast or broadcast transfers to one or more nodes (attached devices) on the  
bus 148. The format of an IEEE 1394 isochronous data packet is illustrated in  
FIG. 1. The packet comprises, generally, a header 12 and a data block 14. The  
25 header 12 specifies the length of the data in the packet 16, an isochronous  
channel number 18 that identifies the nodes to which the isochronous transfer is  
to be directed, a transaction code 20, and a header cyclic redundancy check  
(CRC) 22. A cyclic redundancy check (CRC) 24 is also provided for the data  
block 14. The maximum data payload 26 (indicated by a bracket) of the  
30 isochronous data packet 10 varies with the data capacity of the specific IEEE

1394 serial bus. The maximum payload 26 of the smallest isochronous packet (for a 100 Mbit per sec. bus) is 1024 bytes. To transfer digital video format (DV) data over the serial bus, a DV data packet 30, as illustrated in FIG.2, is inserted into the data field of the IEEE 1394 isochronous data packet 10.

5       The structure of the DV data packet 30 is defined by ISO/IEC 61833-1 and 61833-2, DIGITAL INTERFACE FOR CONSUMER ELECTRONIC AUDIO/VIDEO EQUIPMENT, and is illustrated in FIG. 2. The DV data packet 30 comprises a CIP (Common Isochronous Packet) header 32 and a 480 byte data field 34. The CIP header 32 includes fields for source node identification (SID) 36, data block 10 size (DBS) 38, function number (FN) 40, quadlet packing count (QPC) 42, source packet header (SPH) 44, format identification (FMT) 46, signal type (STYPE) 48, and a time stamp (SYT) 49 for synchronization of video frames.

The data of a DV frame 50 for NTSC television is divided into ten digital interface format (DIF) sequences 52 as illustrated in FIG. 3. A DV frame for PAL 15 television comprises 12 DIF sequences. As illustrated in FIGS. 3 and 4, each DIF sequence 52 comprises 150 DIF blocks 54. A DIF sequence 52 includes a header section (DIF block H0) 70, a subcode section (DIF blocks SC0 and SC1) 72, a video auxiliary section (DIF blocks VA0-VA2) 74, and an audio-video section 75. The audio-video section 75 comprises an audio section (DIF blocks 20 A0-A8) 76 (indicated by a bracket in FIG. 4), and a video section (DIF blocks V0-V134) 78 (indicated by a bracket in FIG. 4). Referring again to FIG. 3, each DIF block comprises a three byte identification (ID) 56 and a 77 byte data section 58. The DIF block ID 56 indicates the type of DIF block (for example, video), the subsequence number and the DIF block number (0 to 134).

25       In the present invention, MPEG-2 transport data stream packets are inserted into the last 76 bytes (the target data block) of the 77 byte data fields 58 of a plurality of video section DIF blocks 78 of one or more DV frames 50. Data is not stored in the first byte of the data field 58 because the DV recorder may alter the value of this byte as an error indicator. When writing to the recorder this byte 30 is usually set to zero indicating no error, although other values are possible. DV

frame packets 30, containing the DV formatted frames, are inserted into the payload of IEEE 1394 isochronous data transfer packets 10 for transfer over the IEEE 1394 bus. At the video recorder, the DV frames are extracted from the bus data stream and stored as DV formatted data on the videotape 154. Referring to

5 FIG. 6, in an embodiment of the invention, the first six bytes of the target data field (the last 76 bytes of the data field 58) are used for MPEG header information 80 and the remaining 70 bytes are used to store the packetized MPEG-2 transport stream data 82. The MPEG header 80 is used by the decoder in extracting

MPEG data from the DV frame structure 50 during playback. As illustrated in

10 FIG. 7, the MPEG header comprises a length field 86 specifying the number of bytes of MPEG data in the DIF block starting from the MPEG ID byte 88 and ending at the last MPEG transport stream data byte of the DIF block 54. If a DIF block contains no MPEG data, the final four fields of the MPEG header 80 will contain no data and the length field 86 will be zero. The MPEG-2 ID field 88

15 contains a unique number that indicates that the data block of the DIF block contains MPEG-2 data. For example, the unique number might be the ASCII character "M" that has the value 77. The version field 90 contains a number indicating the version of the MPEG-2 standard and any MPEG-to-DV data storage specification applicable to the data in the block. On the other hand, the

20 MPEG ID 88 and version 90 fields could be eliminated if the data is known to be MPEG-2 data or if the transport stream validity is checked by the MPEG decoder.

The redundancy field 92 of the DIF block contains an incrementing number indicating when new data is being stored in the DIF block. The DV format utilizes intraframe compression. The MPEG-2 compression process utilizes both

25 intraframe and interframe data compression. The inventors realized that the 22.68 Mbps data capacity of the DV tape may substantially exceed the data rate of the MPEG transport stream 122. For example, standard definition MPEG-2 video has a maximum data rate of six Mbps. When the data rate capacity of the tape exceeds the data rate of the MPEG transport stream, the MPEG data can be

30 stored redundantly on the tape. At 30 frames per second, approximately 200,000

bits of MPEG data must be stored in each DV frame structure 50. However, each DV frame 50 has a data capacity of 756,000 bits and the extra capacity can be used to redundantly store the MPEG data in multiple DIF blocks. If a DIF block is lost in transmission or storage, the data can be recovered from an identical DIF  
5 block in another DIF sequence. Further, when operating in a trick play mode the IEEE 1394 data stream may contain only fragments of each DV frame.  
Depending on trick play speed and data redundancy, it may be possible to reconstruct the original MPEG-2 transport stream from fragments of the DV frames. The redundancy value is a function of the DV frame structure capacity  
10 (756,000 bits) and the MPEG-2 data rate and can be expressed as:

$$Redundancy = \text{floor} \left[ \frac{DVC\_frame\_capacity \cdot DVC\_frame\_rate}{MPEG2\_bit\_rate} \right]$$

15 Referring to FIG. 5, to control the redundant storage of MPEG data, the receiver 104 accumulates 756,000 bits (one DV frame of data) in an accumulation buffer 158 as the MPEG transport stream data arrives at the receiver 104 from the emission station 100. When this quantity of data has been accumulated, it is  
20 placed in the data section of a DV frame 50. This data is repeatedly output to the frame packetizer 150 while the next 756,000 bits of data are received from the emission station 100 and accumulated. The DV packet 30 is sent to the video recorder 154 and the new accumulation of data is then placed in a new DV frame with a redundancy number incremented by one from that of the previous DV  
25 frame. The process is repeated until the entire MPEG transport stream is stored.

When the stored video is played, the data in the DV frames stored on the tape is sent from the recorder 154 to the receiver 104. The MPEG ID field 88 of MPEG header 80 (see FIG. 7) is used to identify the data in the DV frames as  
30 MPEG transport stream data. The offset field 94, see FIG.7, is used to reconstruct the MPEG-2 transport stream. The offset specifies the position of the MPEG data in the DIF block relative to the MPEG data from other DIF blocks of

the current DV frame or in redundant frames. Preferably, the first DIF block of a DV frame has an offset of zero. If this DIF block contains 70 bytes of data, then the offset number of the next DIF block would be 70.

The transport stream is reconstructed by extracting the MPEG data from

- 5 the IEEE 1394 packets in a reconstruction depacketizer 159 and then placing the MPEG-2 data from each of the DIF blocks 54 into a reconstruction buffer 156, illustrated in FIG. 5. The location of specific data in the reconstruction buffer 156 is the sum of the offset value 94 and a frame storage index equal to one byte past the last storage location used by the DVC frames having the previous redundancy
- 10 value. The frame storage index is initially set to zero. If any DIF blocks are missing, redundant DIF blocks 54 from redundant DV frames can be placed into the reconstruction buffer 156. When a frame with a new redundancy value is received, the frame storage index is set to one byte past the last byte stored with the previous redundancy value 92. The MPEG data from the redundant frame is
- 15 then stored at the location identified by the sum of the offset value 94 of the DIF block and the frame storage index. Data from each set of frames with a new redundancy value 92 is appended to the data in the reconstruction buffer 156. A discontinuity in the redundancy value would indicate that a new or discontinuous MPEG-2 transport stream is being received.

- 20 The method and apparatus of the present invention may be used to store data other than MPEG-2 transport stream data on DV tape. For example, files from a PC hard disk or other data that may or may not be related to stored MPEG transport stream data (such as web page uniform resource locators (URLs), recording time, or system information) could be stored on DV tape utilizing the
- 25 method. Further, if the data rate capacity of the DV tape exceeds the data rate of the MPEG transport stream, ancillary data can be stored by the DV recorder utilizing the method. Such ancillary data could include trick play frames to aid in trick play operation (such as, fast forward or reverse operation) of the video recorder. The trick play mode data may include MPEG frames stored redundantly
- 30 on the tape to ensure that data is can be retrieved during fast play modes.

All the references cited herein are incorporated by reference.

- The terms and expressions that have been employed in the foregoing specification are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding equivalents of
- 5 the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims that follow.

What is claimed is:

1. A method of processing data comprising the steps of:
  - (a) copying said data to a data block formatted for digital video; and
  - (b) storing said data block on a storage medium in a digital video storage format.
2. The method of claim 1 wherein said storage medium comprises a digital video tape.
3. The method of claim 1 further comprising the step of copying said data block to a payload portion of an isochronous data transfer packet.
4. The method of claim 1 further comprising the step of repeating said copying of said data to another said data block.
5. A method of storing MPEG transport stream data on a digital video recorder comprising the steps of:
  - (a) copying said transport stream data to a video data block of a digital video frame; and
  - (b) storing said digital video frame on a storage medium.
6. The method of claim 5 wherein said storage medium comprises a digital video tape.
7. The method of claim 5 further comprising the step of copying said digital video frame into an isochronous data transfer packet.

8. The method of claim 5 further comprising the step of repeating said copying of said transport stream data to another said video data block.
9. The method of claim 8 wherein said another video data block is a data element of another said digital video frame.
10. A method of storing MPEG transport stream data with a digital video recorder comprising the steps of:
- (a) copying said transport stream data to a data block of a digital video frame;
  - (b) copying said digital video frame to an isochronous data packet;
  - (c) extracting said digital video frame from said isochronous data packet; and
  - (d) storing said digital video frame in a storage medium.
11. The method of claim 10 further comprising the step of repeating said copying of said transport stream data to another data block.
12. The method of claim 11 wherein said another video data block is a data element of another said digital video frame.
13. A method of storing MPEG transport stream data on a digital video recorder comprising the steps of:
- (a) copying said transport stream data into an isochronous data transfer packet;
  - (b) extracting said transport stream data from said isochronous data transfer packet;

- (c) copying said transport stream data to a video data block of a digital video frame; and
- (d) storing said digital video frame.

5 14. The method of claim 13 further comprising the step of repeating said copying of said transport stream data to another data block.

10 15. The method of claim 14 wherein said another video data block is a data element of another said digital video frame.

15 16. A method of storing MPEG transport stream data with a digital video recorder comprising the steps of:

- (a) accumulating a quantity of said transport stream data equal to a digital video frame data quantity;
- (b) copying said quantity of said transport stream data to a data block of a digital video frame;
- (c) repeating said copying of said quantity of said transport stream data to another said data block as another said quantity of transport stream data is accumulated;
- (d) copying at least one said digital video frame including said data block to a data transfer packet;
- (e) extracting said at least one digital video frame from said data transfer packet; and
- (f) storing said at least one digital video frame.

20 25 17. A method of storing MPEG transport stream data with a digital video recorder comprising the steps of:

- (a) copying said transport stream data to a data transfer packet;
- (b) extracting said transport stream data from said data transfer packet;

- (c) accumulating a quantity of said transport stream data equal to a digital video frame data quantity;
- (d) copying said quantity of said transport stream data to a data block of a digital video frame;
- 5 (e) repeating said copying of said quantity of said transport stream data to another said data block as another said quantity of transport stream data is accumulated; and
- (f) storing said digital video frame.

10 18. An apparatus for storing data with a digital video recorder comprising:

- (a) an accumulation buffer to accumulate a predetermined quantity of said data; and
- (b) a frame packetizer to copy said data to a data block of a digital video frame.

15

19. The apparatus of claim 18 further comprising:

- (a) a transfer packet encoder to copy said digital video frame to a data transfer packet; and
- (b) a depacketizer to extract said digital video frame from said data transfer packet for storage.

20

20. A method of processing data comprising the steps of:

- (a) copying a digital video data block containing said data from a storage medium;
- 25 (b) extracting said data from said digital video data block; and
- (c) formatting said data in a format other than the format of said digital video data block.

30 21. The method of claim 20 wherein said storage medium comprises a digital video tape.

22. The method of claim 23 further comprising the step of copying said formatted data to a payload portion of an isochronous data transfer packet.

23. The method of claim 20 wherein the step of copying said digital video data block from said storage medium comprises the steps of:

5           (a) copying said digital video data block to a payload portion of an isochronous data transfer packet; and

             (b) extracting said digital video data block from said isochronous data transfer packet.

## ABSTRACT OF THE DISCLOSURE

5        A method and apparatus for storing an MPEG-2 transport data stream with  
a conventional digital video (DV) recorder is described. The packetized MPEG-2  
transport stream data is inserted into a data block of a digital video (DV) frame.  
The digital video frame is stored on the storage medium of the DV recorder. The  
DV frame may be inserted into an isochronous data transfer packet for transfer to  
10      the recorder over an IEEE 1394 serial bus. On the other hand, the MPEG  
transport stream data may be transferred to the recorder over the IEEE 1394  
serial bus before the data is inserted into the DV frame for storage. For playback,  
the stored DV frame can be copied into an IEEE 1394 packet for transfer to the  
television receiver where the MPEG data is extracted from the frame, decoded  
15      and presented. On the other hand, the MPEG data may be extracted from the  
stored DV frame before transfer to the receiver over the IEEE 1394 bus.

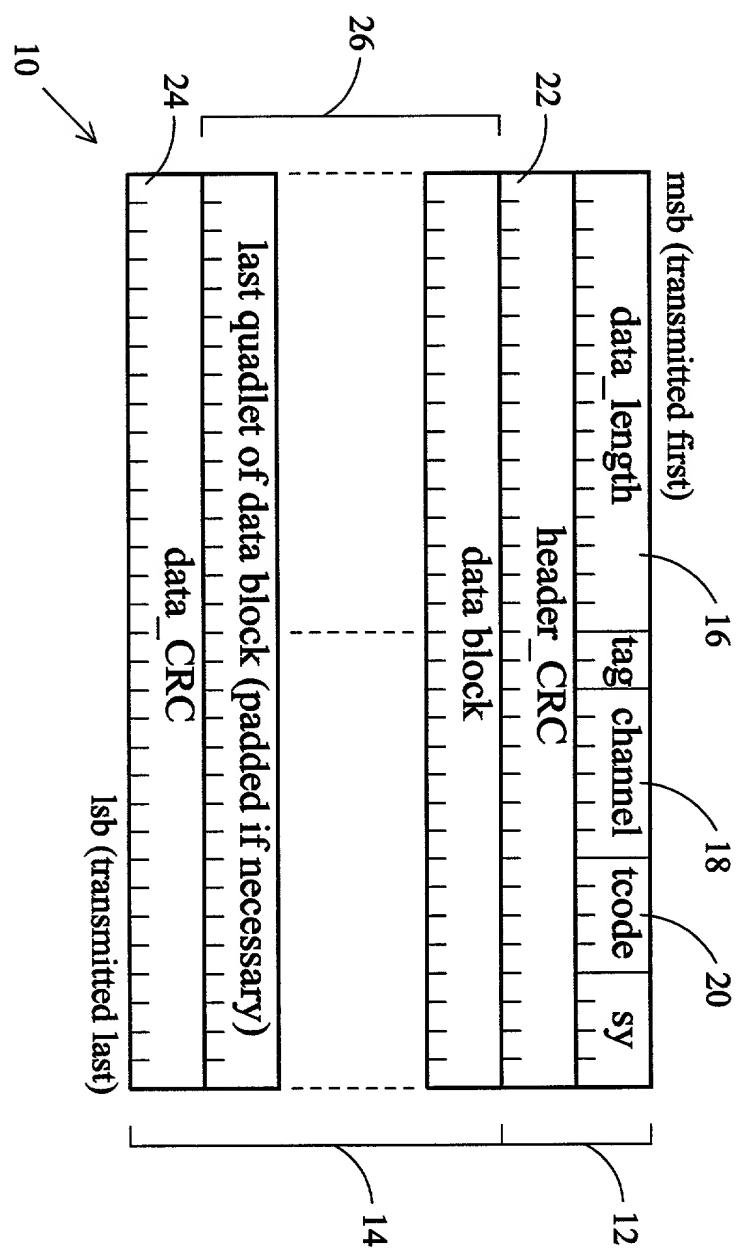


FIG. 1  
(PRIOR ART)

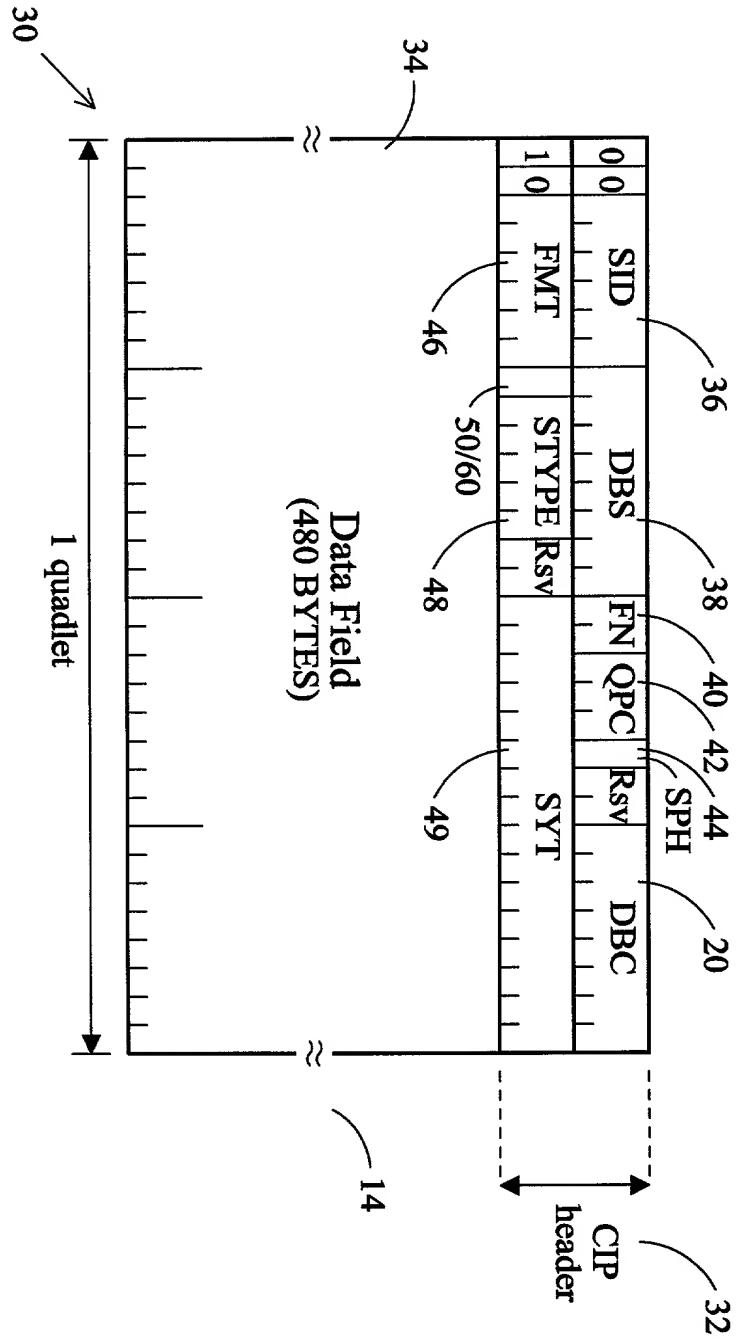
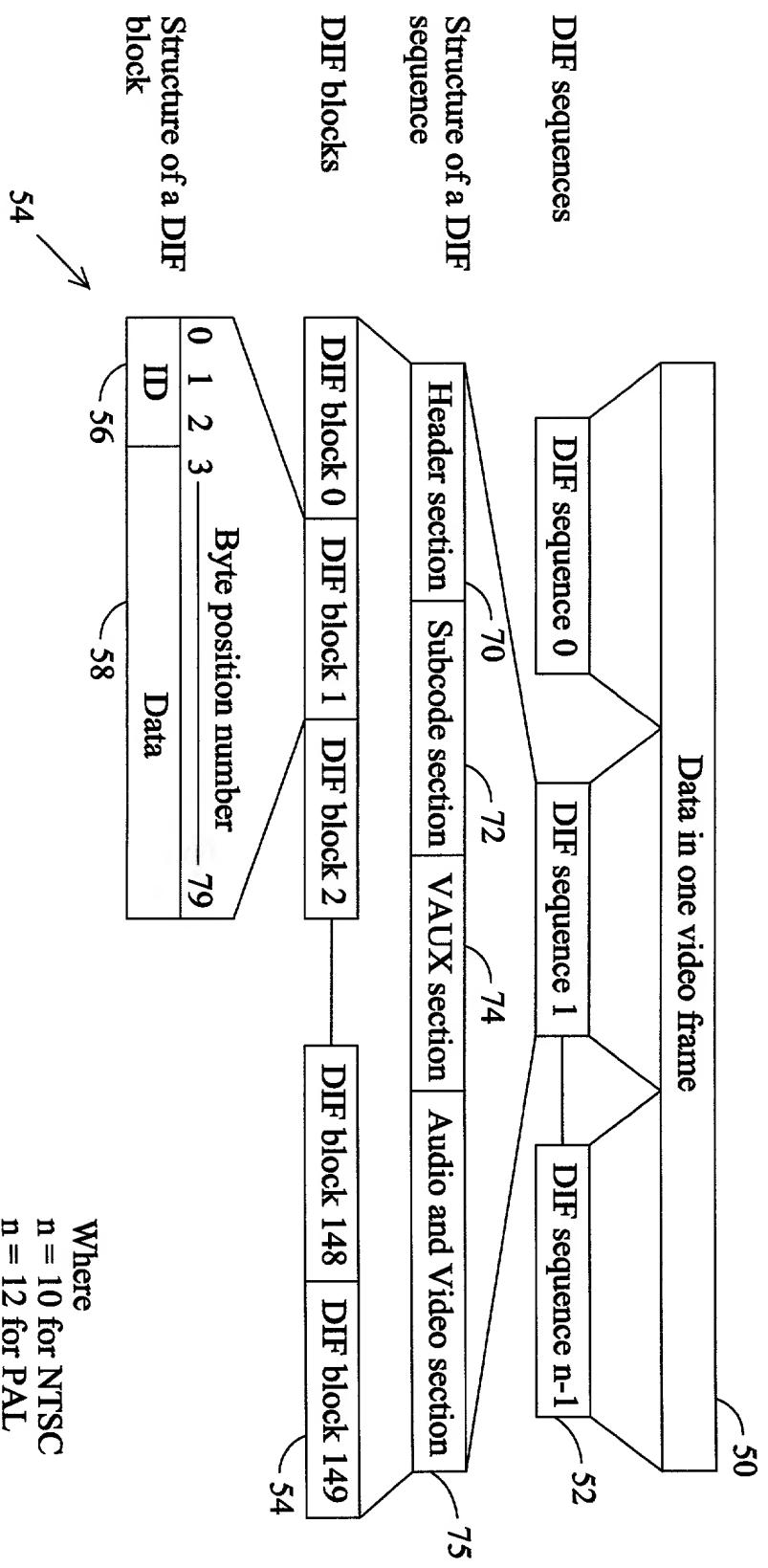


FIG. 2  
(PRIOR ART)



**FIG. 3**  
**(PRIOR ART)**

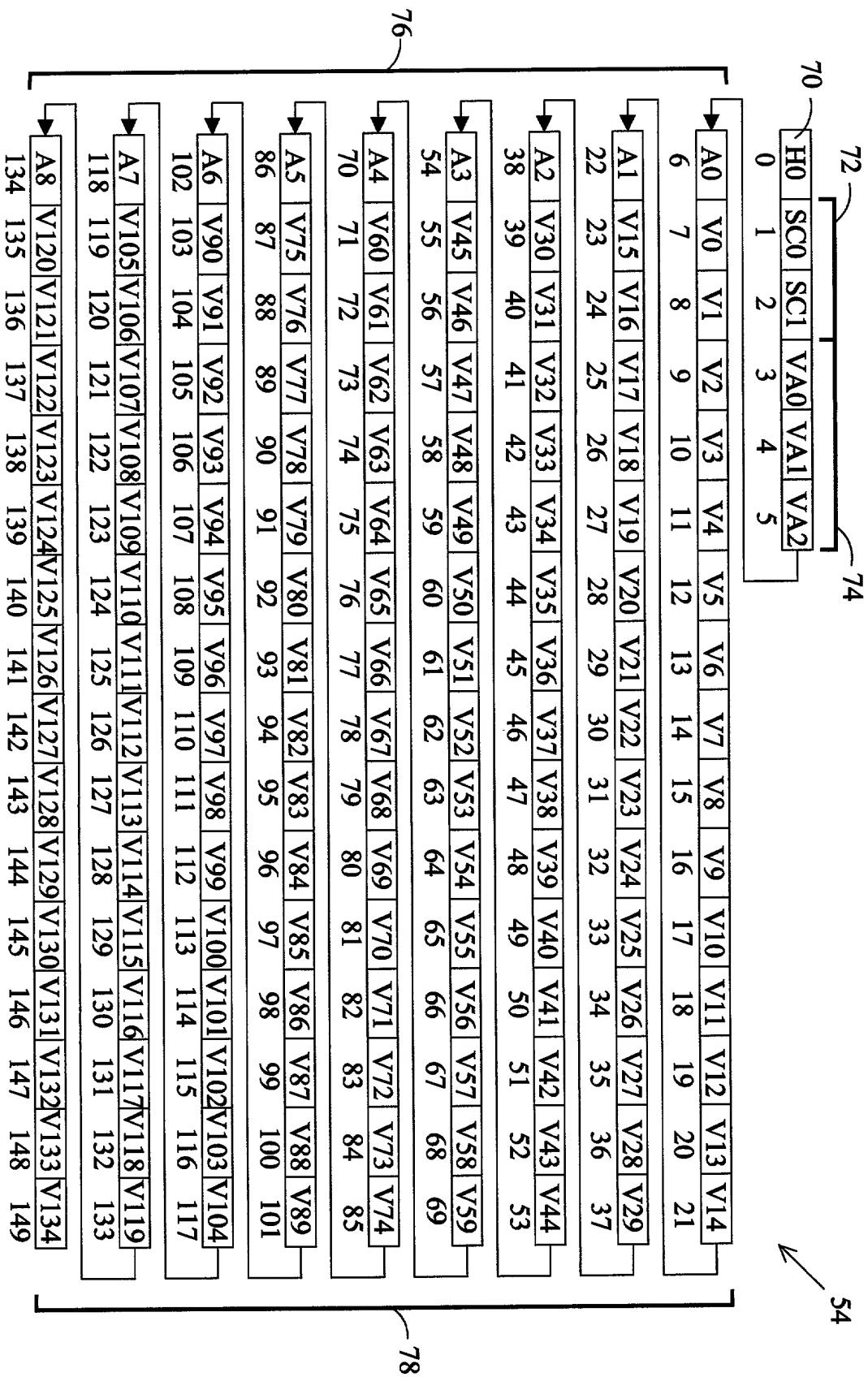


FIG. 4  
(PRIOR ART)

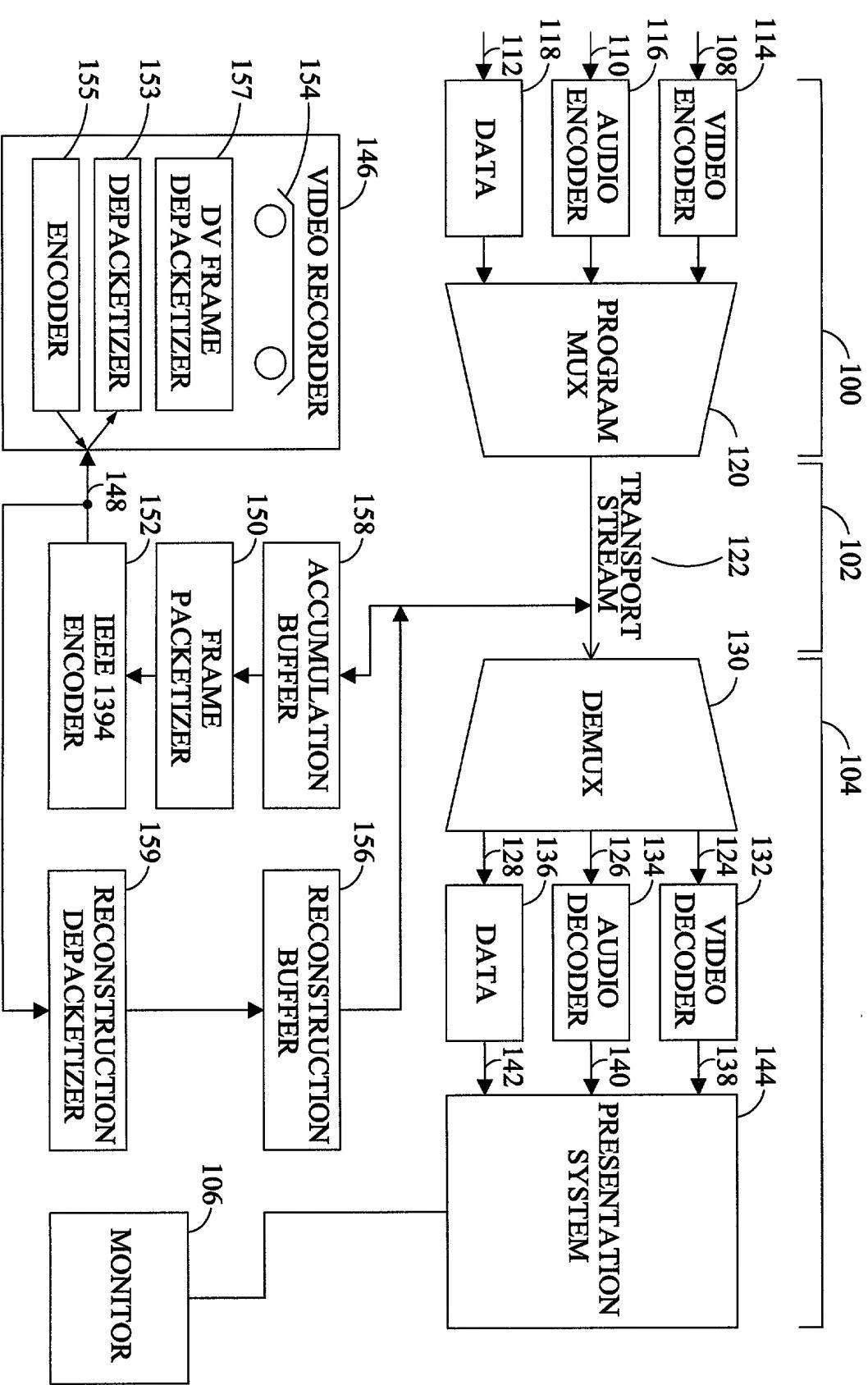
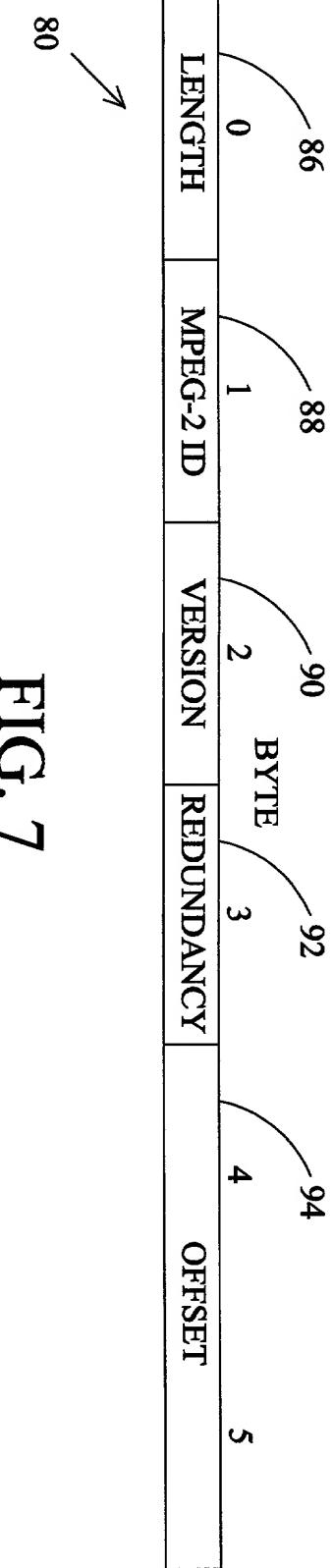
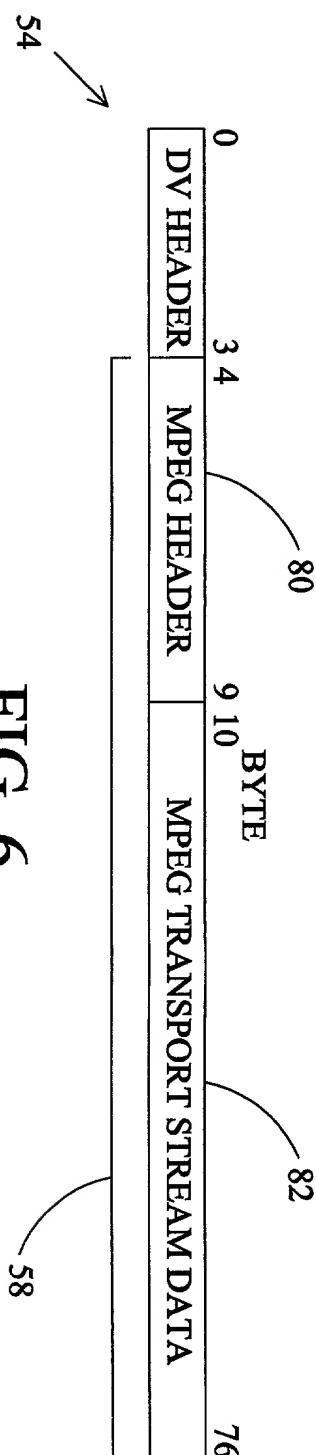


FIG. 5



DECLARATION AND POWER OF ATTORNEY

As the below named inventors, we hereby declare that:

Our residence, post office address and citizenship are as stated below next to our names,

We believe we are the original, first and sole inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND APPARATUS FOR STORING MPEG-2 TRANSPORT STREAMS  
USING A CONVENTIONAL DIGITAL VIDEO RECORDER

the specification of which

[x] is attached hereto.

was filed on \_\_\_\_\_ as  
[ ] Application Serial No. \_\_\_\_\_  
and was amended on \_\_\_\_\_.  
(if applicable)

We hereby state that we have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above.

We acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56.

We hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority  
Claimed

\_\_\_\_\_ [ ] Yes [ ] No  
(Number) (Country) (Day/Month/Year Filed)

\_\_\_\_\_ [ ] Yes [ ] No  
(Number) (Country) (Day/Month/Year Filed)

We hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

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(Application Serial No.)

(Filing Date)

We hereby claim the benefit under Title 35, United States Code, § 120, of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, we acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

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(Application Ser. No.)

(Filing Date)

(Status)

(patented, pending,  
abandoned)

---

(Application Ser. No.)

(Filing Date)

(Status)

(patented, pending,  
abandoned)

We hereby appoint Jacob E. Vilhauer, Jr., Reg. No. 24,885, Charles D. McClung, Reg. No. 26,568, Dennis E. Stenzel, Reg. No. 28,763, Donald B. Haslett, Reg. No. 28,855, William O. Geny, Reg. No. 27,444, Timothy A. Long, Reg. No. 28,876, J. Peter Staples, Reg. No. 30,690, Kevin L. Russell, Reg. No. 38,292, Bruce W. DeKock, Reg. No. 40,585, Nancy J. Moriarty, Reg. No. 40,733, and Timothy E. Siegel, Reg. No. 37,442, all of the firm of Chernoff, Vilhauer, McClung & Stenzel, LLP, 1600 ODS Tower, 601 S.W. Second Avenue, Portland, Oregon 97204, telephone number 503-227-5631, our attorneys, jointly and individually, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false

statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: 12/13/99

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Residence

Citizenship

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant : Bryan S. Hallberg & Jeffrey B. Sampsell

Group Art Unit:

Serial No.:

Examiner:

Filed : Concurrently herewith

Title : METHOD AND APPARATUS FOR STORING MPEG-2 TRANSPORT STREAMS USING A CONVENTIONAL DIGITAL VIDEO RECORDER

Assistant Commissioner for Patents  
Washington, D.C. 20231

**ASSOCIATE POWER OF ATTORNEY (37 C.F.R. 1.34)**

Please recognize as Associate Practitioner in this case:

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Address: 5750 NW Pacific Rim Blvd.

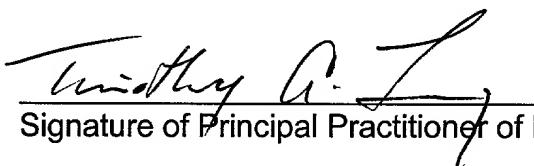
Camas WA 98607

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**CORRESPONDENCE**

All correspondence concerning this application is to be directed to the **principal practitioner of record** at the **address below**.



Signature of Principal Practitioner of Record

Reg. No. 28,876

Timothy A. Long

Chernoff, Vilhauer, McClung & Stenzel L.L.P.  
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE UNDER 37 CFR §3.73(b)

Applicant : Bryan Severt Hallberg and Jeffrey Brian Sampsell

Serial No : \_\_\_\_\_ Filed: Concurrently herewith

Title : METHOD AND APPARATUS FOR STORING MPEG-2 TRANSPORT STREAMS  
USING A CONVENTIONAL DIGITAL VIDEO RECORDER

Sharp Laboratories of America, Inc.,  
(Assignee)

a Washington Corporation  
(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

certifies that it is the assignee of the entire right, title and interest in the patent application identified above by virtue of either:

A.  An assignment from the inventor(s) of the patent application identified above, a copy of which is submitted herewith.

OR

B.  A chain of title from the inventor(s), of the patent application identified above, to the current assignee as shown below:

1. From: \_\_\_\_\_ To: \_\_\_\_\_  
The document was recorded in the Patent and Trademark Office at Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy is attached.

2. From: \_\_\_\_\_ To:  
The document was recorded in the Patent and Trademark Office at Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy is attached.

Additional documents in the chain of title are listed on a supplemental sheet.

Copies of assignments or other documents in the chain of title are attached. (Where one or more of the documents is unrecorded.)

The undersigned has reviewed all the documents in the chain of title of the patent application identified above and, to the best of undersigned's knowledge and belief, title is in the assignee identified above.

The undersigned (whose title is supplied below) is empowered to sign this Certificate on behalf of the assignee.

I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further, that these statements are made with the knowledge that willful false statements, and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code,

and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date : December 16, 1999

Name : Timothy A. Long

Title : Attorney for the Assignee (a copy of the Power of Attorney is attached)

Signature : 

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